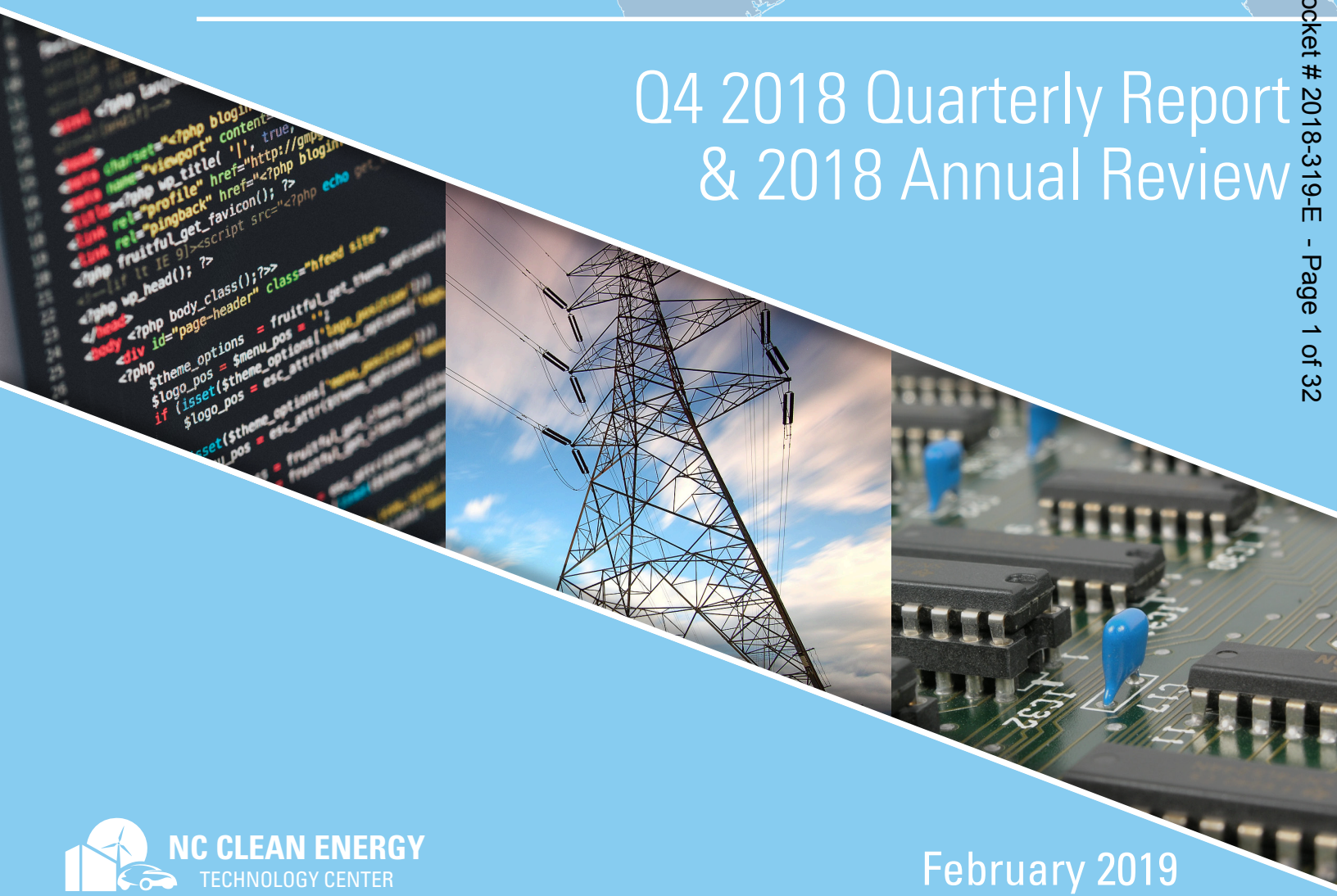
EXHIBIT 4

50 States of GRID MODERNIZATION

Q4 2018 Quarterly Report & 2018 Annual Review



NC CLEAN ENERGY TECHNOLOGY CENTER

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The NC Clean Energy Technology Center is a UNC System-chartered Public Service Center administered by the College of Engineering at North Carolina State University. Its mission is to advance a sustainable energy economy by educating, demonstrating and providing support for clean energy technologies, practices, and policies. The Center provides service to the businesses and citizens of North Carolina and beyond relating to the development and adoption of clean energy technologies. Through its programs and activities, the Center envisions and seeks to promote the development and use of clean energy in ways that stimulate a sustainable economy while reducing dependence on foreign sources of energy and mitigating the environmental impacts of fossil fuel use.

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Previous executive summaries and older editions of *The 50 States of Grid Modernization* are available for download here.

In addition to *The 50 States of Grid Modernization*, the NC Clean Energy Technology Center publishes additional quarterly reports called *The 50 States of Solar* and *The 50 States of Electric Vehicles*. These reports may be purchased at here. Executive summaries and older editions of these reports are available for download here.

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GLOSSARY OF ABBREVIATIONS

ALJ	Administrative Law Judge
d/b/a	Doing Business As
DER	Distributed Energy Resource
DG	Distributed Generation
FERC	Federal Energy Regulatory Commission
GW	Gigawatt
IOU	Investor-Owned Utility
IRP	Integrated Resource Plan
ISO	Independent System Operator
kW	Kilowatt
kWh	Kilowatt-Hour
MW	Megawatt
NEM	Net Energy Metering
PACE	Property Assessed Clean Energy
PPA	Power Purchase Agreement
PV	Photovoltaics
REC	Renewable Energy Credit (or Certificate)
RPS	Renewable Portfolio Standard
RTO	Regional Transmission Organization
TOU	Time-of-Use

OVERVIEW

WHAT IS GRID MODERNIZATION?

Grid modernization is a broad term, lacking a universally accepted definition. In this report, the authors use the term grid modernization broadly to refer to actions making the electricity system more resilient, responsive, and interactive. Specifically, in this report grid modernization includes legislative and regulatory actions addressing: (1) smart grid and advanced metering infrastructure, (2) utility business model reform, (3) regulatory reform, (4) utility rate reform, (5) energy storage, (6) microgrids, and (7) demand response.

PURPOSE

The purpose of this report is to provide state lawmakers and regulators, electric utilities, the advanced energy industry, and other energy stakeholders with timely, accurate, and unbiased updates about how states are choosing to study, adopt, implement, amend, or discontinue policies associated with grid modernization. This report catalogues proposed and enacted legislative, regulatory, and rate design changes affecting grid modernization during the most recent quarter.

The 50 States of Grid Modernization report series provides regular quarterly updates and annual summaries of grid modernization policy developments, keeping stakeholders informed and up to date.

APPROACH

The authors identified relevant policy changes and deployment proposals through state utility commission docket searches, legislative bill searches, popular press, and direct communications with industry stakeholders and regulators.

Questions Addressed

This report addresses several questions about the changing U.S. electric grid:

- How are states adjusting traditional utility planning processes to better allow for consideration of advanced grid technologies?
- What changes are being made to state regulations and wholesale market rules to allow market access for distributed energy resources?
- How are states and utilities reforming the traditional utility business model and rate designs?

- What policy actions are states taking to grow markets for energy storage and other advanced grid technologies?
- Where and how are states and utilities proposing and deploying advanced grid technologies, energy storage, microgrids, and demand response programs?

Actions Included

This report focuses on cataloguing and describing important proposed and adopted policy changes related to grid modernization and distributed energy resources, *excluding policies specifically intended to support only solar technologies*. While some areas of overlap exist, actions related to distributed solar policy and rate design are tracked separately in the *50 States of Solar report series,* and are generally not included in this report.

In general, this report considers an "action" to be a relevant (1) legislative bill that has been introduced or (2) a regulatory docket, utility rate case, or rulemaking proceeding. Only statewide actions and those related to investor-owned utilities are included in this report. Specifically, actions tracked in this issue include:

Studies and Investigations

Legislative or regulatory-led efforts to study energy storage, grid modernization, utility business model reform, or alternative rate designs, e.g., through a regulatory docket or a cost-benefit analysis.

Planning and Market Access

Changes to utility planning processes, including integrated resource planning, distribution system planning, and evaluation of non-wires alternatives, as well as changes to state and wholesale market regulations enabling market access.

Utility Business Model and Rate Reform

Proposed or adopted changes to utility regulation and rate design, including performance-based ratemaking, decoupling, time-varying rates, and residential demand charges.

Grid Modernization Policies

New state policy proposals or changes to existing policies related to grid modernization, including energy storage targets, energy storage compensation rules, interconnection standards, and customer data access policies.

Financial Incentives for Energy Storage and Advanced Grid Technologies

New statewide incentives or changes to existing incentives for energy storage, microgrids, and other modern grid technologies.

Deployment of Advanced Grid Technologies

Utility-initiated requests, as well as proposed legislation, to implement demand response programs or to deploy advanced metering infrastructure, smart grid technologies, microgrids, or energy storage.

Actions Excluded

This report excludes utility proposals for grid investments that do not include any specific grid modernization component, as outlined above, as well as specific projects that have already received legislative or regulatory approval. Actions related exclusively to pumped hydroelectric storage or electric vehicles are not covered by this report (a separate report series available from the NC Clean Energy Technology Center covers electric vehicle actions). Time-varying and residential demand charge proposals are only documented if they are being implemented statewide, the default option for all residential customers of an investor-owned utility, or a notable pilot program. Actions related to inclining or declining block rates are not included in this report. While actions taken by municipal utilities and electric cooperatives are not comprehensively tracked in this report, particularly noteworthy or high-impact actions are included. The report also excludes changes to policies and rate design for distributed generation customers; these changes are covered in the 50 States of Solar quarterly report.

2018 ANNUAL REVIEW

THE U.S. ELECTRICITY SYSTEM IN TRANSITION

The U.S. electricity grid is currently in a state of transition. The system was historically a "one-way street", with power flowing from utility-owned centralized generation, via utility-owned transmission and distribution lines, toward end-use consumers. However, the electric system is increasingly becoming more of an interconnected web, with small but growing numbers of end-use customers also generating at least some of their own electricity with small-scale, distributed systems that are often capable of providing various services to the grid.

Technology is making rapid advancements, continuing to offer new benefits to the electric system. Policy, however, has not kept pace with the speed of technical energy advancements, with most U.S. electricity policy still focused primarily on the traditional one-way, centralized system model and its industry structure and related institutions. This is changing, though, with more and more states initiating investigations into advanced grid technologies and proposing legislative and regulatory changes intended to enable the development of a modern electric system.

Grid Modernization

Grid modernization is an expansive topic, capturing the many individual pieces of the transition occurring in our nation's energy system. A major element of this transition is the deployment of new technologies, such as advanced metering infrastructure and smart grid technologies, including communications, monitoring, and control technologies for managing distributed energy resources of all kinds. These technologies offer the opportunity to bring new benefits to both utilities and consumers, including economic, environmental, reliability, security, and consumer experience benefits.

The deployment of advanced grid technologies is already underway. The market for distributed generation, namely solar photovoltaics, is already scaling rapidly, while the energy storage market is expected to grow from an expected 6 GW of annual installed capacity in 2017 to over 40 GW in 2022.[1] Utilities had already deployed nearly 76 million smart meters by the end of 2017, covering over 55% of U.S. households, and more installations are underway.[2]

But before advanced grid technologies can be utilized to their fullest extent, regulatory structures must be examined to determine whether current regulations are resulting in outdated or unintended barriers to deployment. By reevaluating regulatory frameworks, business models, and rate designs, an energy system that allows for full and open evaluation of technological options, greater market participation, and fair assignment of related benefits and costs can be created.

Over half of U.S. states are currently examining these regulatory frameworks or actively working to deploy advanced grid technologies. This activity is expected to continue, much like the ongoing evaluation of state solar policies, as states and utilities conduct studies, try new approaches, and learn from one other about how best to achieve the many benefits of a more modern grid.

2018 GRID MODERNIZATION ACTION

Table 1 provides a summary of state actions related to grid modernization occurring during 2018. Of the 460 actions catalogued, the most common were those related to policies (113), followed by deployment of grid modernization technologies (81), and planning and market access (78). The actions occurred across 44 states plus DC in 2018 (Figure 1). Box 1 highlights the states that saw the most grid modernization action during 2018, which are described in greater detail in the following sections.

Table 1. 2018 Summary of Grid Modernization Actions

Type of Action	# of Actions	% by Type	# of States
Policies	113	25%	35 + DC
Deployment	81	18%	33
Planning and Market Access	78	17%	26 + DC
Studies and Investigations	75	16%	32 + DC
Business Model and Rate Reform	67	15%	25 + DC
Financial Incentives	46	10%	20
Total	**460**	**100%**	**44 States + DC**

Note: The "# of States/ Districts" total is not the sum of the rows because some states have multiple actions. Percentages are rounded and may not add up to 100%.

Figure 1. 2018 Legislative and Regulatory Action on Grid Modernization

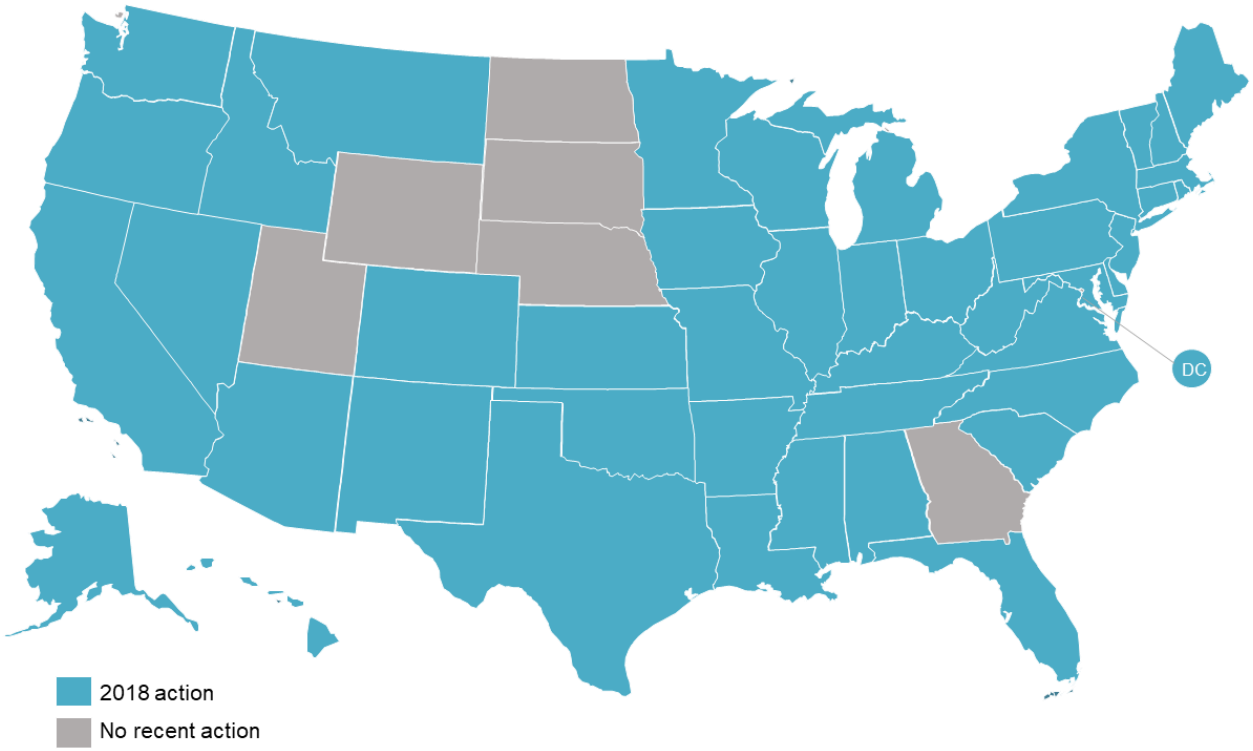
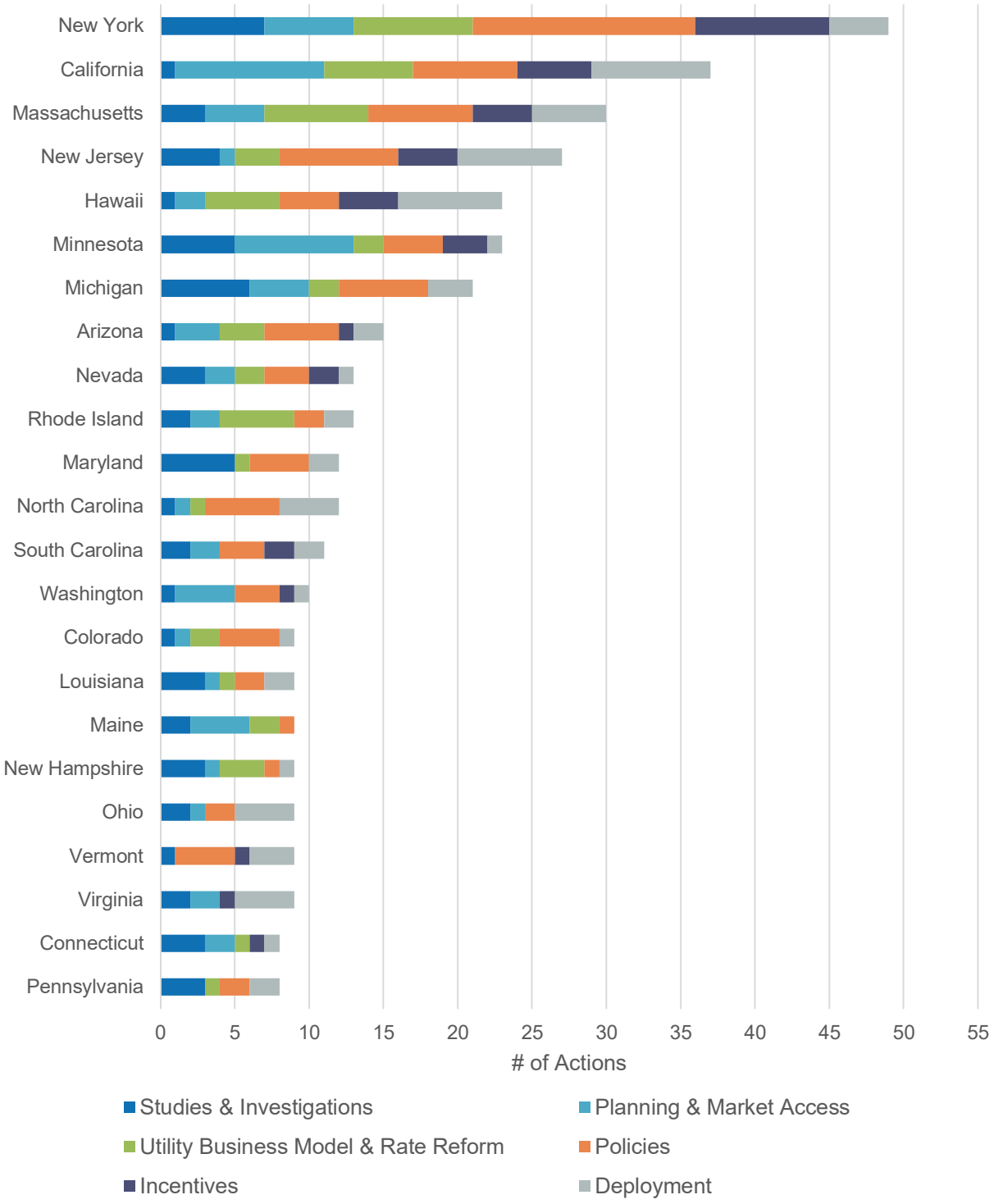


Figure 2. Most Active States of 2018

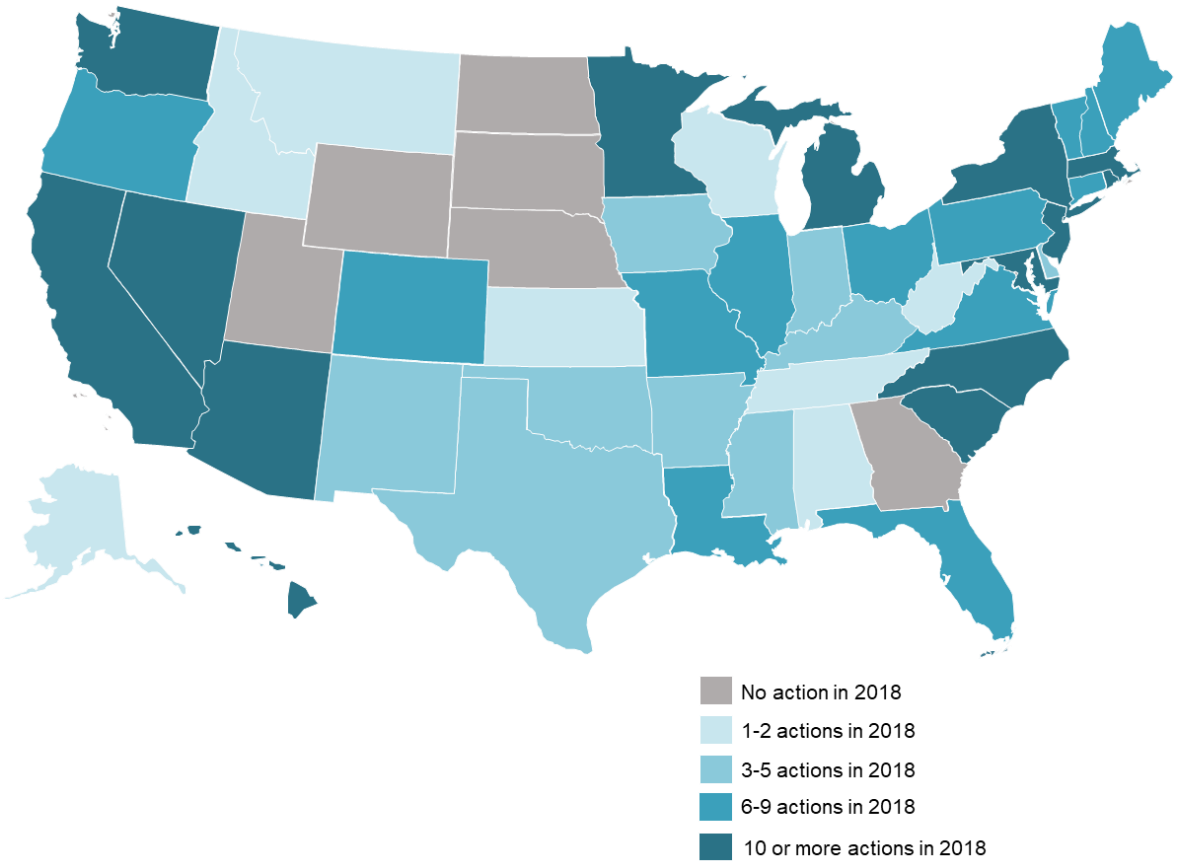


Nearly all U.S. states took actions related to grid modernization in 2018. New York and California again took the greatest number of actions during the year, followed by Massachusetts, New Jersey, Hawaii, and Minnesota (see Figure 2). Each state took a unique approach to grid modernization in 2018, with some having more comprehensive agendas, while

others focused on a few specific categories of actions. Furthermore, while some states are addressing many grid modernization issues within single proceedings, other states are addressing various issues related to grid modernization in individual dockets.

Eight states took actions in all six grid modernization categories covered by this report – studies and investigations, planning and market access, utility business model and rate reform, policies, financial incentives, and deployment. The category with the greatest number of actions tracked in 2018 was policies, largely due to the wide array of grid modernization policies under consideration and significant amount of legislation proposed in 2018.

Figure 3. 2018 Grid Modernization Activity, by Number of Actions



Geographically, the greatest number of actions were taken on the coasts, as well as the upper Midwest. Grid modernization activity continues to increase in these regions, while also spreading to new states. In 2018, 44 states and DC took grid modernization actions, compared to 39 and DC in 2017. New states taking grid modernization actions in 2018 include Alabama, Delaware, Kansas, Tennessee, West Virginia, and Wisconsin. Utah addressed grid modernization in 2017, but did not take any actions covered by this report in 2018. Activity also increased in the most active states for grid modernization; for example, New York took 33 actions in 2017 and 49 in 2018.

Total grid modernization action has skyrocketed over the past year, with states and utilities taking approximately 288 actions in 2017 and 460 actions in 2018 (See Figure 4). Note that several actions were considered in both years. In 2018, activity also increased in every category of grid modernization actions. Activity related to policies showed the most dramatic growth, nearly doubling from 2017 to 2018. The number of states taking actions in each grid modernization category also increased from 2017 to 2018, with policies also seeing the greatest jump in states, from 26 in 2017 to 35 in 2018 (See Figure 5).

Figure 4. Number of Grid Modernization Actions 2017-2018

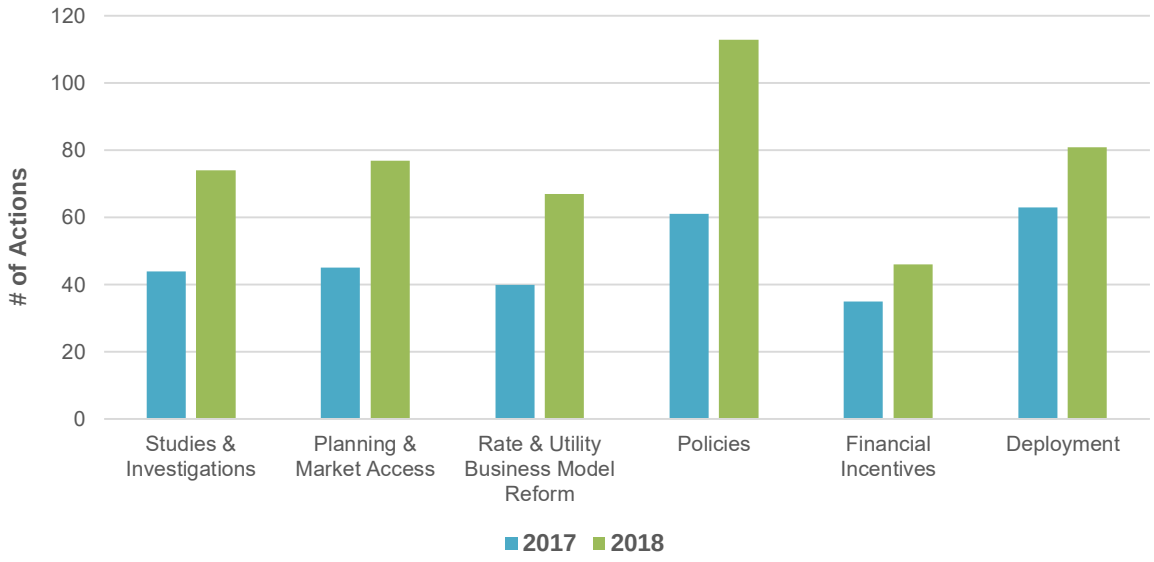


Figure 5. Number of States Taking Grid Modernization Actions 2017-2018

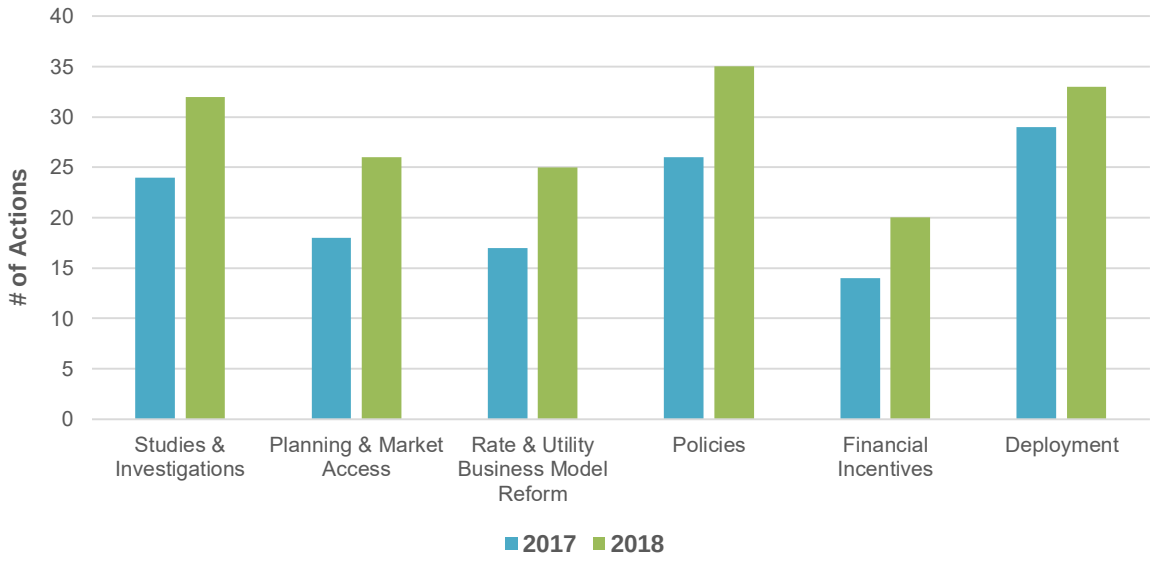
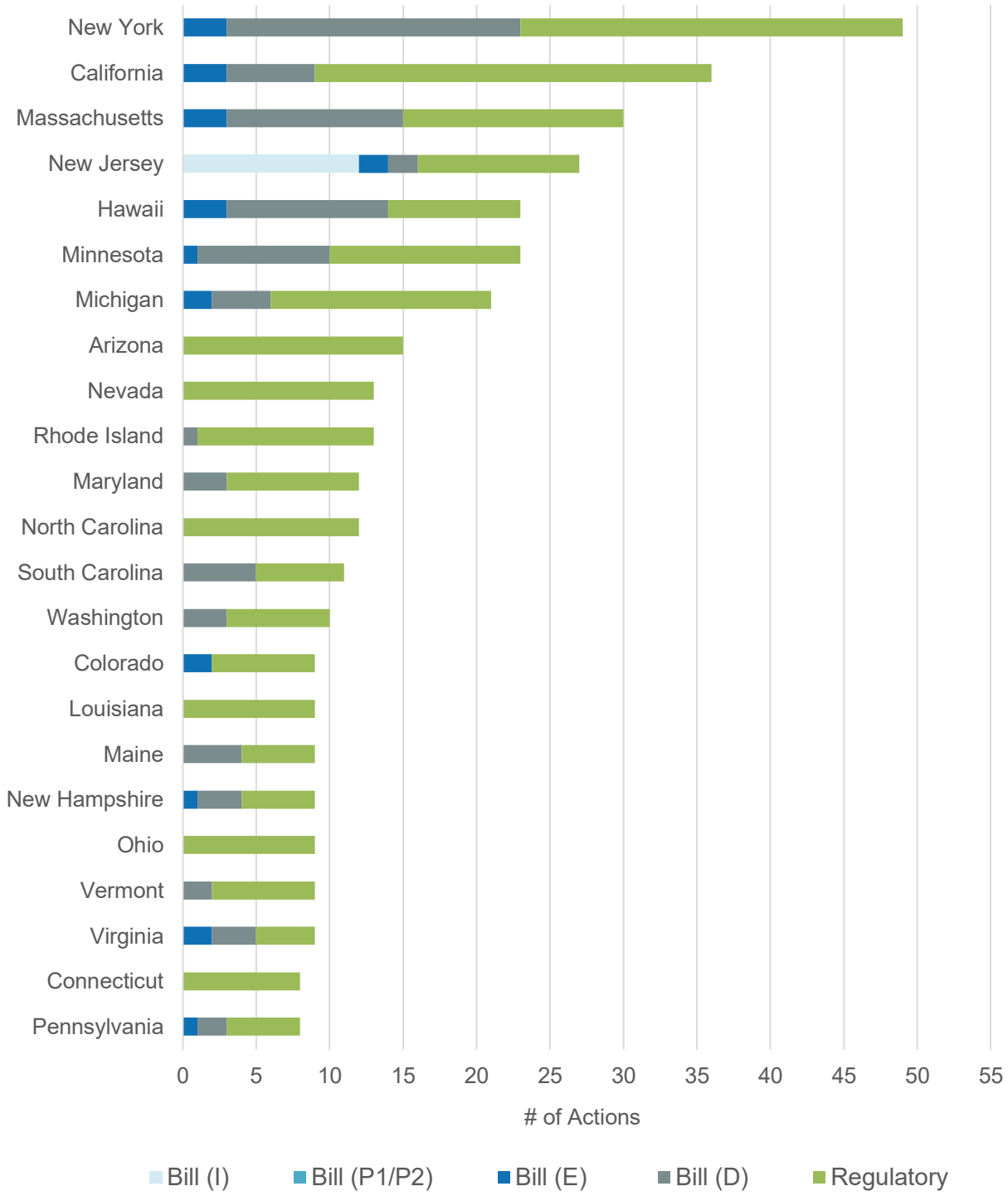


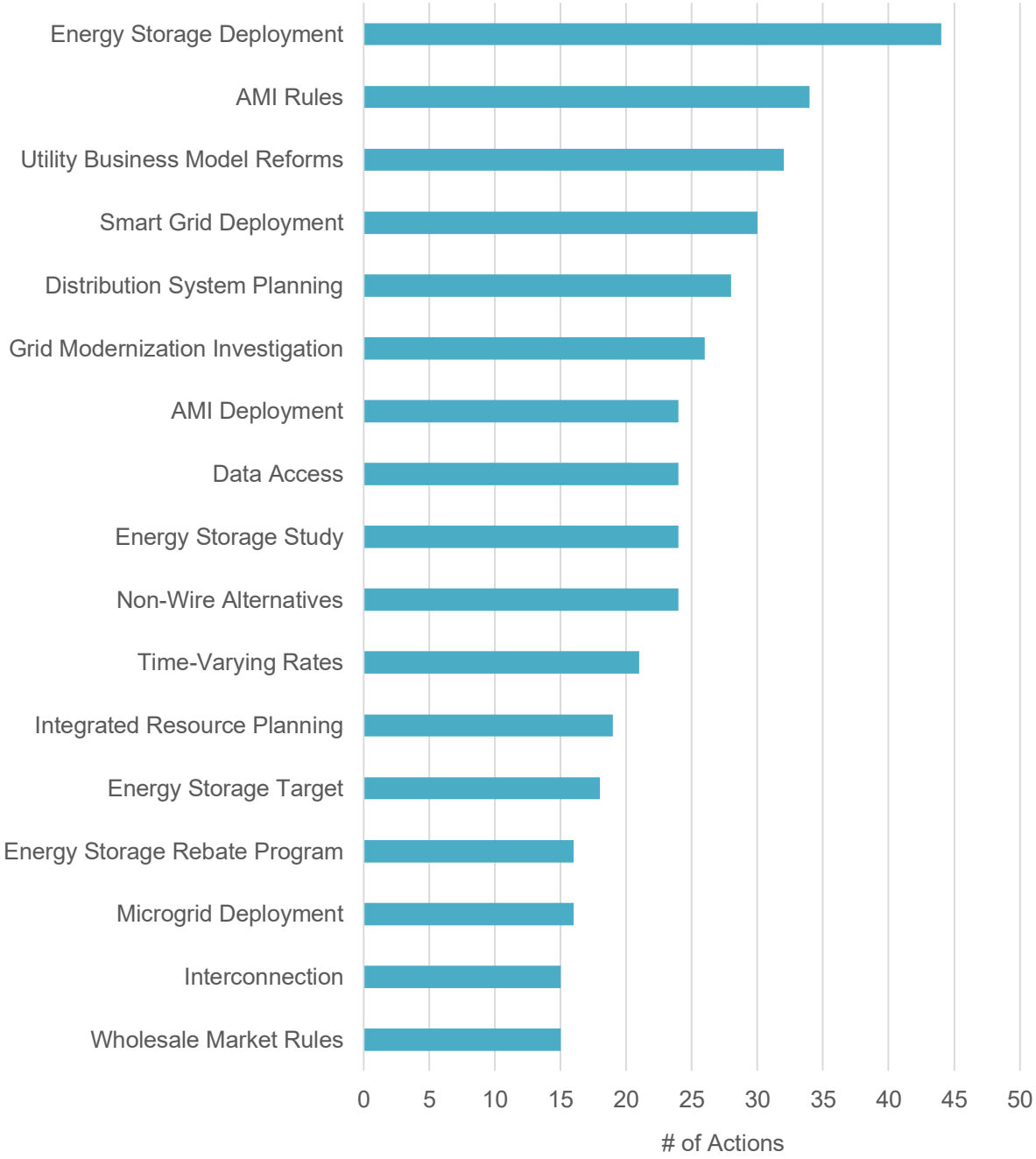
Figure 6. Most Active States of 2018, by Action Status



While 460 actions related to grid modernization were taken in 2018, not all of these resulted in legislative or regulatory decisions. Figure 6 displays the most active states of 2018 by the status of each action taken. For the purposes of this graph, each individual action is assigned a status, so bills containing several different grid modernization components may be counted multiple

times. Bills enacted in 2018 that later led to regulatory action are counted as enacted bills. The graph is therefore not intended to be a precise representation, but rather to show that while some states can be considered very active, not all of the actions counted lead to policy changes or technology deployments.

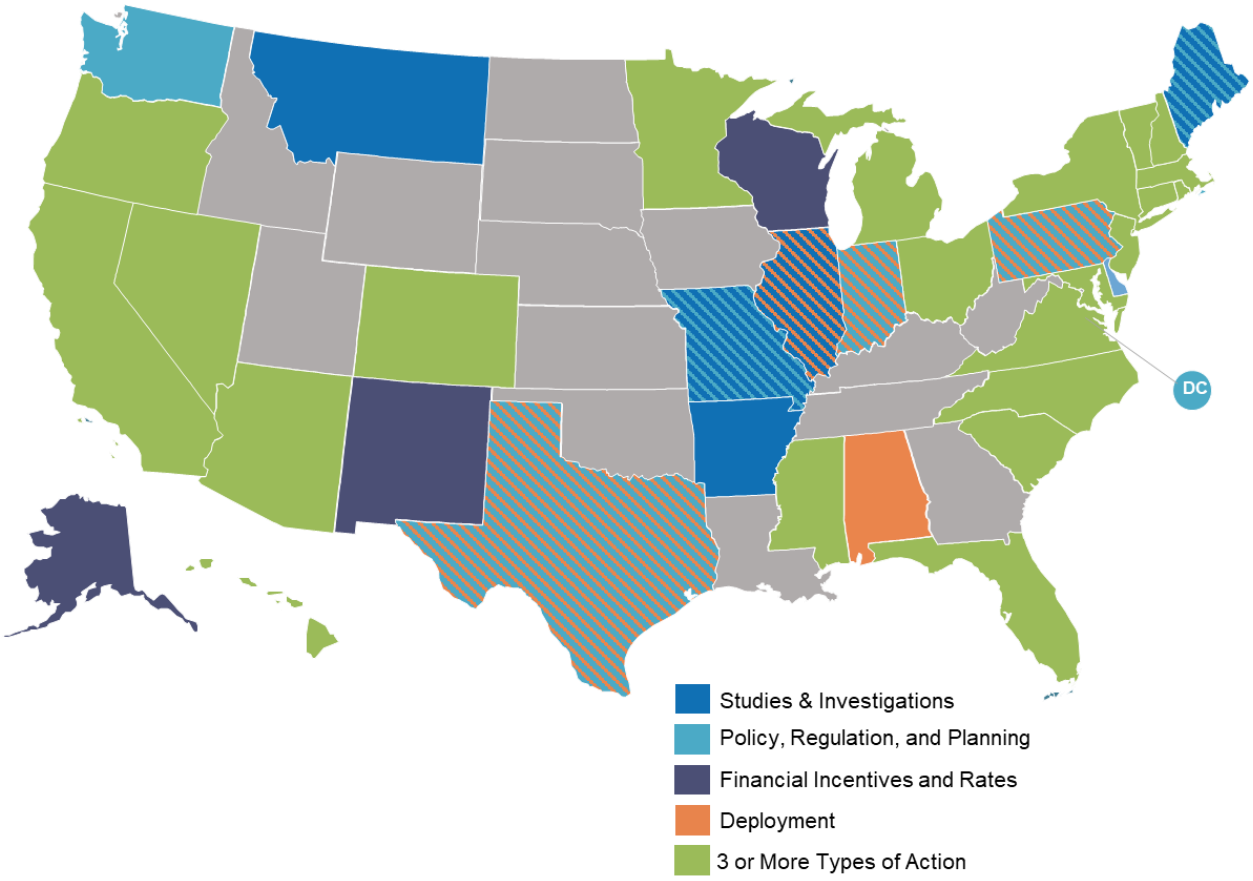
Figure 7. Most Common Types of Actions Taken in 2018



The most common type of grid modernization action taken in 2018 was energy storage deployment, followed by advanced metering infrastructure (AMI) rules, and utility business model reforms. Several states and utilities are moving beyond some of the foundational steps of

grid modernization, such as investigatory proceedings and AMI deployment, and moving on toward developing distribution system planning rules, establishing data access standards, considering utility business model reforms, and deploying smart grid and energy storage technologies.

Figure 8. 2018 Action on Energy Storage, By Type of Action



At least 36 states took action specifically related to energy storage during 2018, with the majority of these states considering at least three types of storage actions (See Figure 8). Of the top actions taken during 2018, four relate specifically to energy storage: energy storage deployment, studies, procurement targets, and rebates. Several other types of common actions also frequently involve energy storage, such as those relating to distribution system planning, non-wires alternatives, integrated resource planning, interconnection rules, and microgrid deployment.

Box 1. Top Ten Most Active States of 2018

New York

New York adopted an energy storage target of 1,500 MW by 2025 and 3,000 MW by 2030, while the Public Service Commission (PSC) Staff developed a roadmap for achieving these targets. The PSC also approved interconnection standards for energy storage systems and a Hybrid Tariff for compensating eligible generators paired with energy storage. Several bills related to grid modernization were also considered during the year.

Nevada

The Public Utilities Commission of Nevada approved distribution system planning rules in 2018, as well as a revised version of integrated resource planning rules. The Commission also finalized NV Energy's energy storage rebate program, addressed interconnection issues for energy storage systems, and published an energy storage study, which found that 700 to 1,000 MW of utility-scale battery storage could be cost-effectively deployed by 2030.

Hawaii

Hawaii's investor-owned utilities filed their integrated grid planning report in 2018, proposing a new planning procedure that merges separate processes. The utilities also requested approval of their Phase 1 grid modernization projects, focusing on AMI, as well as multiple energy storage projects. Hawaii lawmakers enacted bills requiring a transition to performance-based ratemaking and directing the Public Utilities Commission to create a microgrid services tariff.

New Jersey

New Jersey lawmakers adopted an energy storage target of 2,000 MW by 2030 and initiated an energy storage study in 2018. Meanwhile, Atlantic City Electric, Jersey Central Power & Light, and PSE&G New Jersey proposed a variety of grid modernization investments and incentive programs. New Jersey is also developing its 2019 Energy Master Plan, which will incorporate several aspects of grid modernization.

California

California utilities requested approval for several energy storage and demand response projects in 2018. State lawmakers also enacted a bill to establish microgrid interconnection and compensation rules, and regulators considered distribution system planning, default time-varying rates, utility energy storage rebates for low-income customers, modifications to the Self-Generation Incentive Program, and more.

(Cont'd) Top Ten Most Active States of 2018

Ohio

The Public Utilities Commission of Ohio (PUCO) concluded its PowerForward grid modernization investigation in 2018, opening three new dockets that relate to ongoing stakeholder efforts (the PowerForward Collaborative), distribution system planning, and data access. PUCO also considered smart grid and energy storage investment proposals from Ohio Power Company, Duke Energy Ohio, and Dayton Power & Light.

Massachusetts

The Massachusetts General Court adopted the country's first clean peak standard in 2018, while also expanding the state's energy storage target from 200 MWh by 2020 to 1,000 MWh by 2025. The Department of Public Utilities issued a decision on grid modernization investment plans from the state's three investor-owned utilities and considered performance-based incentive mechanisms for Eversource and National Grid.

Michigan

The Michigan Public Service Commission (PSC) published a report on performance-based regulation and also considered distribution system planning rules and customer data access standards during 2018. Consumers Energy and DTE filed distribution investment and maintenance plans, and Upper Peninsula Power Company filed an AMI deployment proposal. The PSC is also investigating interconnection and demand response aggregation issues.

Minnesota

The Minnesota Public Utilities Commission approved interconnection standards for energy storage systems, as well as integrated distribution planning requirements. The Commission is also working to develop performance incentive mechanisms and issued a decision on proposed grid modernization investments from Xcel Energy. State lawmakers considered several bills related to energy storage during 2018.

Arizona

The Arizona Corporation Commission considered a broad Energy Modernization Plan put forward by Commissioner Tobin in 2018, later opening a rulemaking docket addressing several different energy modernization issues, including energy storage and blockchain technology. The Commission also worked to develop interconnection standards for energy storage and directed Tucson Electric Power and UNS Electric to file data access plans and rate tariffs for customers with multiple types of distributed energy resources.

Box 2. Top Grid Modernization Trends of 2018

States and Utilities Undertaking Distribution System Planning Efforts

Regulators in several states, including Michigan, Missouri, Nevada, and Washington, considered distribution system planning rules in 2018. The Public Utilities Commission of Nevada formally adopted rules, while the Minnesota Public Utilities Commission established integrated distribution planning requirements. Regulators in Delaware and Ohio initiated dockets on distribution system planning in 2018 as well.

States Studying the Value of Energy Storage and Policy Options

Three states – Maryland, Nevada, and North Carolina – completed studies focused on energy storage in 2018, while New York published an energy storage roadmap. Although each study has a different goal, they all consider policy options to encourage storage development. Legislation was enacted in New Jersey and Virginia in 2018 initiating energy storage studies.

Regulators Rejecting and Scaling Back Utility Grid Modernization Proposals

Many of the grid modernization investment plans put forward by utilities in 2018 were rejected or significantly scaled back by regulators. AMI proposals in Kentucky, Massachusetts, and New Mexico were rejected, while expansive grid modernization plans put forward by utilities in North Carolina, Rhode Island, and Virginia were scaled back substantially, with some regulators urging utilities to present revised plans and budgets for the rejected elements.

Growing Movement Toward Performance-Based Regulation

States are increasingly considering performance-based regulation as an alternative to traditional cost-of-service regulation. Massachusetts regulators evaluated performance incentive mechanisms put forward by Eversource and National Grid, and the Hawaii State Legislature enacted a bill requiring a transition to performance-based ratemaking. Michigan, Minnesota, Oklahoma, and Rhode Island also saw action related to performance-based regulation in 2018.

Utilities Requesting Special Ratemaking Treatment for Grid Investments

Several utilities requested special ratemaking treatment for grid modernization investments in 2018. Duke Energy Carolinas requested approval for a new grid rider for its PowerForward grid investment plan in North Carolina, which regulators rejected in 2018. Three New Jersey utilities – Atlantic City Electric, Jersey Central Power & Light, & PSE&G New Jersey – all proposed new riders in 2018 as well, which are currently under consideration.

(Cont'd) Top Grid Modernization Trends of 2018

States Concluding Grid Modernization Investigations, Identifying Next Steps

Ohio and Oregon concluded their grid modernization investigations in 2018, publishing final reports with findings and recommended next steps. The Illinois Commerce Commission also published a draft final report on its NextGrid initiative in 2018. Proceedings in Colorado and Connecticut are also ending, and rulemakings and decisions have been coming out of Maryland's PC 44 proceeding.

States Establishing Clear Standards for Energy Storage Interconnection

Several states are reexamining interconnection rules in order to create clear requirements for energy storage systems. The Minnesota Public Utilities Commission approved revised rules including energy storage provisions in 2018, and the Public Utilities Commission of Nevada resolved certain energy storage interconnection issues. Rulemaking proceedings are also open in Arizona and Maryland, where energy storage interconnection standards are under consideration.

Regulators Considering Rules for Access to Customer Usage Data

Rules governing access to customer energy usage data are coming under consideration in several states, especially as AMI is more fully deployed. The Michigan Public Service Commission required utilities to file data privacy tariffs, and the Public Utilities Commission of Ohio opened a new proceeding on data access in 2018. A proceeding is also open in Maryland, and Arizona regulators directed certain utilities to develop a data access process for customers.

Utilities Proposing AMI Opt-Out Tariffs and Fees

As utilities continue to deploy AMI, the issue of opt-out options for customers is being addressed more frequently. In 2018, regulators considered opt-out tariffs for at least 11 utilities, with upfront opt-out fees ranging from $0 to $170 and monthly fees ranging from $5.00 to $25.89. Some utilities are also proposing additional provisions, such as requiring customers to provide meter readings or requiring statements from medical physicians.

Wholesale Market Operators Revising Rules to Expand Energy Storage Participation

The Federal Energy Regulatory Commission issued Order 841 in February 2018, directing wholesale market operators (Independent System Operators and Regional Transmission Organizations) to establish rules that enable energy storage resources to participate in energy, capacity, and ancillary services markets. ISOs and RTOs filed their plans to comply with the order in December 2018, and the changes will need to be implemented by December 3, 2019.

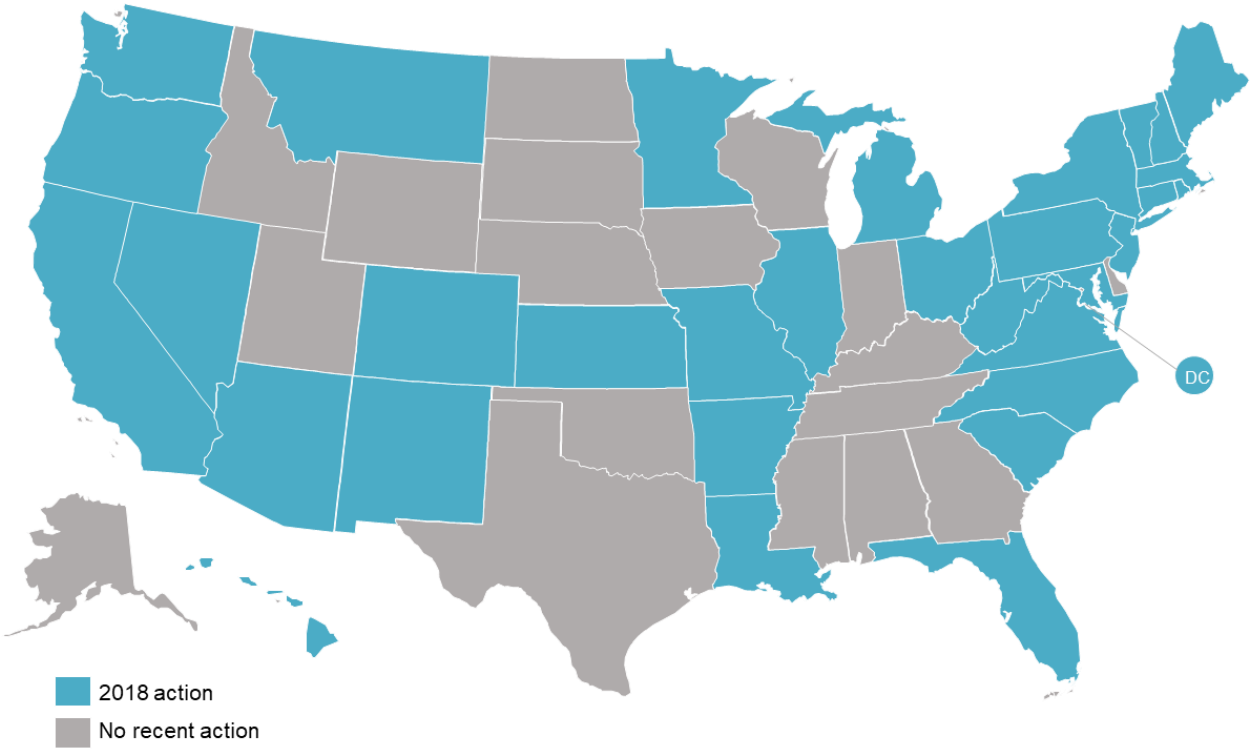
STUDIES AND INVESTIGATIONS REVIEW

Key Takeaways:

- In 2018, 32 states plus DC took action to study or investigate issues related to grid modernization, energy storage, demand response, and rate reform.
- Nine state legislatures considered bills to conduct studies or investigations in 2018, with new laws enacted in four of those states.
- Sixteen studies or investigations were completed in 14 states during 2018.

Policymakers and regulators in nearly half of U.S. states are working proactively to prepare their electricity systems for the future. New technologies promise a stronger and more flexible grid, but require a thoughtful analysis of their impacts and in some cases, a consideration of regulatory changes needed to enable their deployment. As a first step, policymakers or regulators in 32 states and DC studied (or proposed to study) some element of grid modernization during 2018 – up from 24 states and DC in 2017.

Figure 9. 2018 Action on Grid Modernization Studies and Investigations



Lawmakers in nine states considered legislation commissioning studies or investigations into some element of grid modernization, with bills enacted in five of these states – Massachusetts, Michigan, New Hampshire, New Jersey, and Virginia. Massachusetts' bill calls for a study of a mobile battery storage system, as well as the creation of a research center for energy storage.

New Hampshire's bill was more broadly aimed, creating a legislative committee to oversee grid modernization topics. New Jersey and Virginia both commissioned energy storage studies, and Michigan legislators adopted a resolution encouraging the state's energy agency to hold a stakeholder discussion on incorporating energy storage into the energy market.

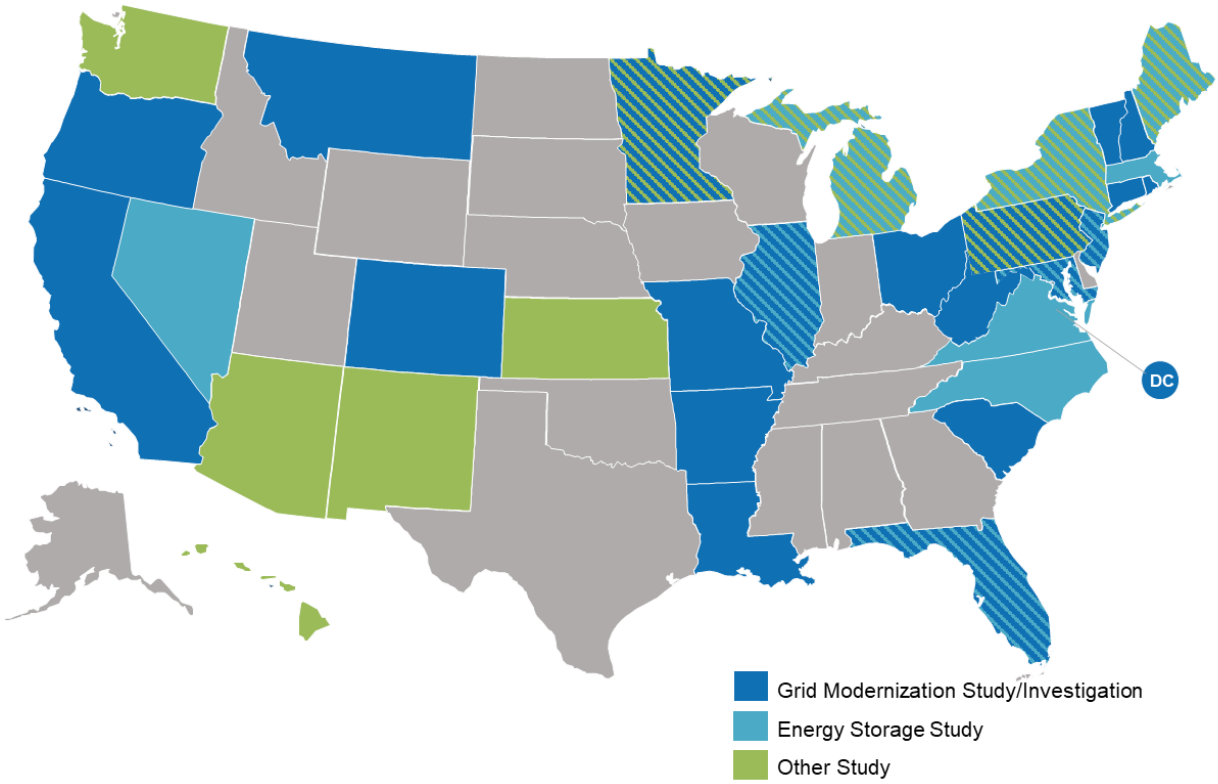
Table 2. State-Initiated Energy Storage Studies Overview

State	Origin	Date	Directive	Results
MD	H.B. 773	Dec. 2018	Study of regulatory reforms and market incentives that are necessary or beneficial to increase the use of energy storage devices in the state.	Presents a variety of policy options and finds three the most relevant to Maryland: removing barriers by updating rate designs and regulations, adopting targets and/or incentives, and overseeing distribution system planning.
MA	Governor	Sept. 2016	Policy and regulatory recommendations along with a cost-benefit analysis.	Recommended the achievement of 600 MW of advanced energy storage by 2025, which the authors estimate would result in $800 million in system benefits to ratepayers.
NC	H.B. 589	Dec. 2018	Study the potential value of energy storage to North Carolina consumers, feasibility of storage in the state, economic potential or impact of storage deployment, and recommended policy changes.	Some applications are currently cost-effective, while most become cost-effective by 2030. Study presents policy options to prepare for, facilitate, and accelerate storage deployment.
NV	S.B. 204	Oct. 2018	Determine whether it is in the public interest to establish an energy storage procurement target.	By 2020, 175 MW of utility-scale battery storage can be deployed cost-effectively, increasing to 700 MW – 1,000 MW by 2030. Behind-the-meter storage could add up to 300 MW by 2030.
NJ	A.B. 3723	Due May 2019	Quantify potential benefits and costs of increasing storage in the state and recommend policies to increase storage opportunities, including financial incentives.	Not yet completed.
NY	Governor	June 2018	Plan an approach and make recommendations to achieve the Governor's 1,500 MW storage target.	Identifies policies, regulations, and initiatives that will help meet the Governor's statewide energy storage target of 1,500 MW by 2025.
VA	H.B. 5002	Due Sept. 2019	Determine whether or not legislation adopting regulatory reforms and incentives will be helpful in encouraging emerging energy storage capacity in the state.	Not yet completed.
VT	Act 53	Oct. 2017	Examine opportunities for, benefits of, and barriers to energy storage deployment; regulatory options and structures that can foster energy storage; and potential methods for fostering the development of cost-effective energy storage and the benefit and cost impacts on ratepayers.	Recommended that in the utilities include storage analyses in IRPs and in the long term, evaluating cost-benefit methodologies to create a more concrete framework for utility evaluation of storage. Does not recommend changes to interconnection rules and recommends against adoption of a storage target at this time.

States studying energy storage in particular was a major trend of 2018, with four energy storage studies completed during the year and two new studies initiated. Each state's energy storage study has a slightly different focus and goal, but they all consider policy options to cost-effectively expand energy storage development. Some studies also include more quantitative analyses, such as studies conducted by Massachusetts and North Carolina, in order to evaluate

which energy storage applications could provide the most benefit to the state. Table 2 provides a comparison of state-initiated energy storage studies.

Figure 10. 2018 Action on Studies and Investigations by Topic



Sixteen studies or investigations on grid modernization were completed across 14 states in 2018. Two studies were completed in both Louisiana and New York. Four of these studies, conducted in Maryland, Nevada, New York, and North Carolina, focused specifically on energy storage, while many of the remaining studies examined grid modernization more broadly and some focused on specific topics, such as performance-based regulation, demand response potential, or customer choice for AMI installation.

The Public Utilities Commission of Ohio (PUCO) concluded its PowerForward investigation in 2018, publishing a report summarizing findings from the efforts and recommending next steps. PUCO is focusing on continued stakeholder engagement, distribution system planning, and data issues following the investigation. Oregon's S.B. 978 final report was also published, outlining recommended legislative and regulatory steps to address six priority areas identified by the report: (1) climate change; (2) affordability, equity, and environmental justice; (3) customer options; (4) utility incentive alignment; (5) regional market development; and (6) participation.

The Illinois Commerce Commission also released a draft final report from its NextGrid process. The report covers seven areas addressed by working groups: (1) new technology and grid integration; (2) electricity markets; (3) customers and community participation; (4) regulatory,

environmental, and policy issues; (5) metering, communications, and data; (6) reliability, resiliency, and cybersecurity; and (7) ratemaking.

Table 3. Grid Modernization Studies and Reports Completed in 2018

State	Completion Date	Study Name and Link
Louisiana	4/10/2018	Entergy New Orleans, LLC's Grid Modernization and Smart Cities Report
Washington	4/10/2018	Policy and Interpretive Statement on Customer Choice for Advanced Meter Installation
Michigan	4/20/2018	Report on the Study of Performance-Based Regulation
West Virginia	6/8/2018	Report on Emerging and State-of-the-Art Concepts in Utility Management, Rate Design, and Conservation
Ohio	8/29/2018	PowerForward: A Roadmap to Ohio's Electricity Future
Oregon	9/14/2018	SB 978: Actively Adapting to the Changing Electricity Sector
Nevada	10/2/2018	The Economic Potential for Energy Storage in Nevada
Louisiana	10/12/2018	Analysis of Long-Term Achievable Demand Response Potential
Colorado	10/31/2018	No report
Pennsylvania	11/15/2018	Pennsylvania's Solar Future Plan
Connecticut	11/26/2018	No report
North Carolina	12/5/2018	Energy Storage Options for North Carolina
New York	12/12/2018, 12/14/2018	Staff Whitepaper on Standby and Buyback Service Rate Design and Residential Voluntary Demand Rates
New York	12/13/2018	Order Establishing Energy Storage Goal and Deployment Policy
Illinois (Draft)	12/14/2018	NextGrid Illinois Utility of the Future Study
Maryland	12/19/2018	Energy Storage in Maryland

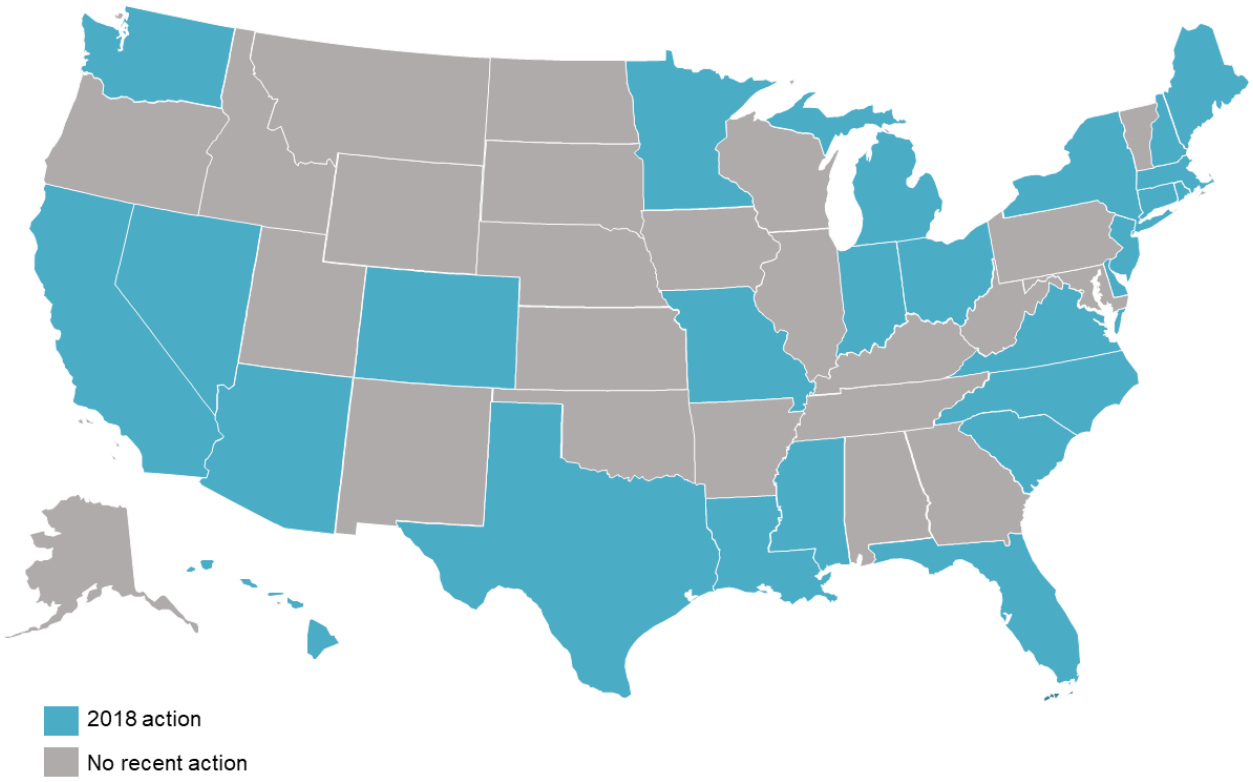
PLANNING AND MARKET ACCESS REVIEW

Key Takeaways:

- In 2018, 26 states + DC considered changes to utility planning processes and state regulations enabling market access.
- Six ISOs/RTOs took action related to wholesale market rules for energy storage or demand response.
- Seventeen states addressed distribution system planning rules during the year, with seven of those states also addressing possible updates to integrated resource planning practices. An additional four states addressed integrated resource planning, but not explicitly distribution system planning rules.

As the potential roles for energy storage and other distributed energy resources within our energy system grow more important, policymakers and regulators are working to revise both wholesale market rules and planning procedures to ensure these resources are appropriately considered in utility planning and can participate in wholesale markets. In 2018, 26 states and DC considered changes to planning processes and market access rules.

Figure 11. 2018 State Action on Planning and Market Access

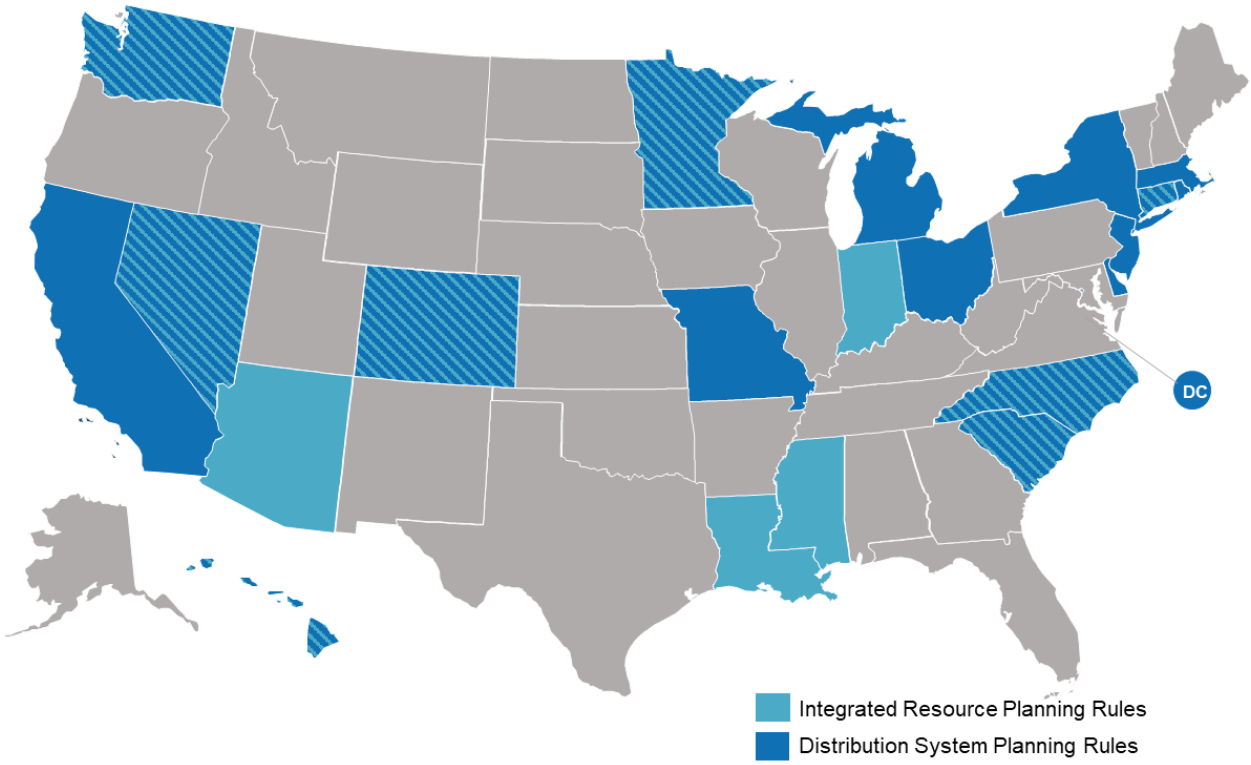


Distribution system planning was a major topic of interest in 2018, with 17 states and DC addressing issues related to distribution system planning during the year. Missouri, Nevada,

and Washington regulators considered statewide distribution system planning rules in 2018, with Nevada approving rules in October 2018. The Minnesota Public Utilities Commission evaluated integrated distribution planning requirements for individual utilities, and Xcel Energy filed its integrated distribution plan in November 2018. The Delaware Public Service Commission also opened a distribution system planning docket in 2018, while Colorado and Connecticut stakeholders spent considerable time considering distribution system planning issues in investigatory dockets.

A notable trend emerging in 2018 was the development of more holistic planning processes, bringing generation, transmission, and distribution planning together into one coordinated process. Hawaii's investor-owned utilities proposed integrated grid planning process in 2018, while Duke Energy presented its integrated systems operation planning process in North Carolina and South Carolina.

Figure 12. 2018 State Action on Utility Planning Processes



Regulators in several states also examined integrated resource planning rules during 2018. The Mississippi Public Service Commission opened a proceeding to develop the state's first integrated resource planning rules, while Indiana regulators approved revisions to the state's resource planning rules to require consideration of energy storage resources. The Public Utilities Commission of Nevada also approved revised integrated resource planning rules, implementing legislation enacted in 2017 that requires the Commission to give preference to supply sources providing the greatest economic and environmental benefits to the state.

Table 4. Grid Planning Rules Under Consideration in 2018

State	Grid Planning Rule / Report	Status
Hawaii	Integrated Grid Planning Report	Under Consideration
Indiana	Integrated Resource Planning Proposed Rule	Approved
Michigan	Distribution Planning Framework	Under Consideration
Missouri	Distributed Energy Resource Analysis Rules	Under Consideration
Minnesota	Integrated Distribution Planning Requirements for Xcel Energy	Approved
Minnesota	Integrated Distribution Planning Requirements for Otter Tail Power	Under Consideration
Minnesota	Integrated Distribution Planning Requirements for Minnesota Power	Under Consideration
Nevada	Distributed Resource Planning Rules	Approved
Nevada	Integrated Resource Planning Rules	Approved
Washington	Distribution Planning Draft Rules	Under Consideration

Independent system operators (ISOs) are also examining market access and compensation for energy storage resources, largely in response to FERC Order 841, issued in February 2018. FERC Order 841 requires wholesale market operators to establish rules allowing energy storage to fully participate in energy, capacity, and ancillary services markets. Market operators were required to file proposed tariff changes by December 3, 2018, and will have to comply with the order by December 3, 2019.

Another FERC proceeding is addressing distributed energy resource (DER) aggregation in wholesale markets. FERC held a technical conference on DERs in April 2018 where parties argued whether aggregated DERs should be allowed to participate in FERC-regulated markets or not. While some parties supported allowing participation by aggregated DERs, other parties suggested that the issue should be decided by individual utilities.

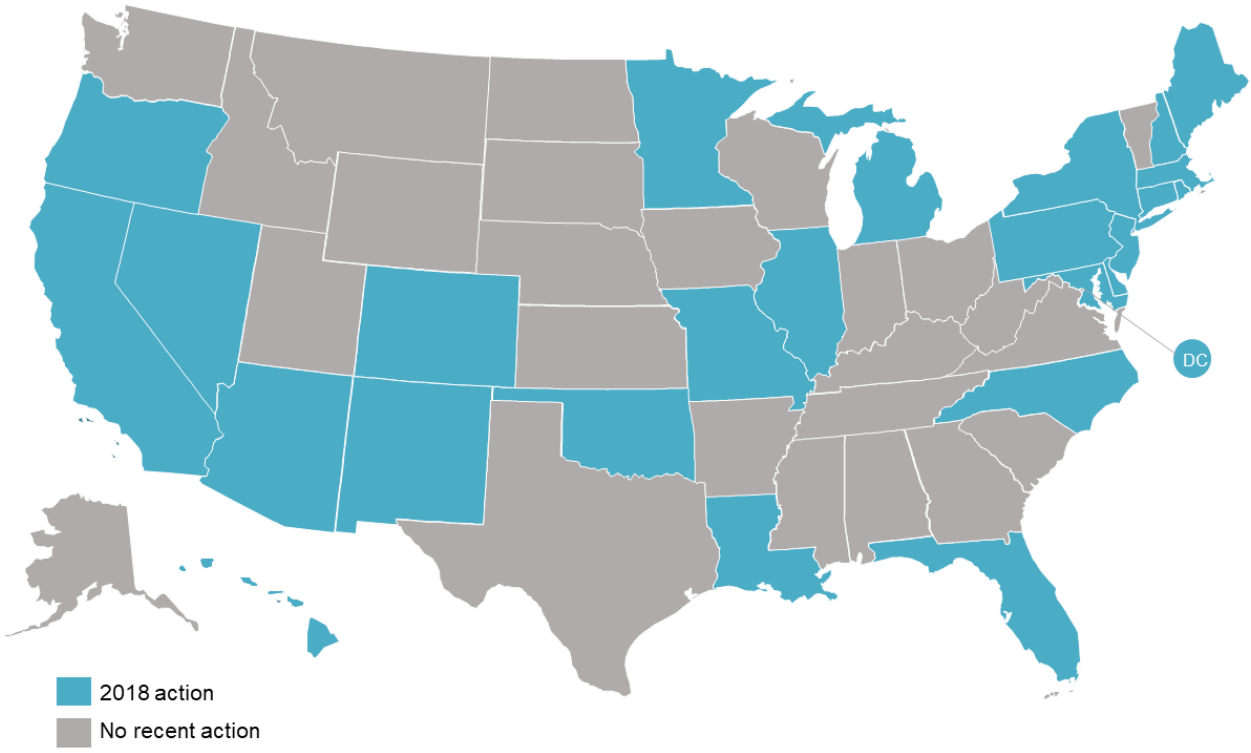
UTILITY BUSINESS MODEL AND RATE REFORM REVIEW

Key Takeaways:

- In 2018, 25 states plus DC took 67 actions to reform rate designs, regulatory structures, or utility business models.
- Nineteen states considered ratemaking or utility business model reforms, including decoupling, performance-based ratemaking, and deregulation.
- Fifteen states and DC considered rate design reforms, including time-varying rates and demand charges.

A growing number of states and utilities are reexamining traditional rate designs and utility business models. Rate design has the potential to encourage or discourage particular technologies from being adopted by end-use consumers, including energy storage systems and other distributed energy resources. Utility business models, on the other hand, can play a large role in incentivizing or dis-incentivizing utilities from investing in particular technologies.

Figure 13. 2018 Action on Utility Business Model and Rate Reforms

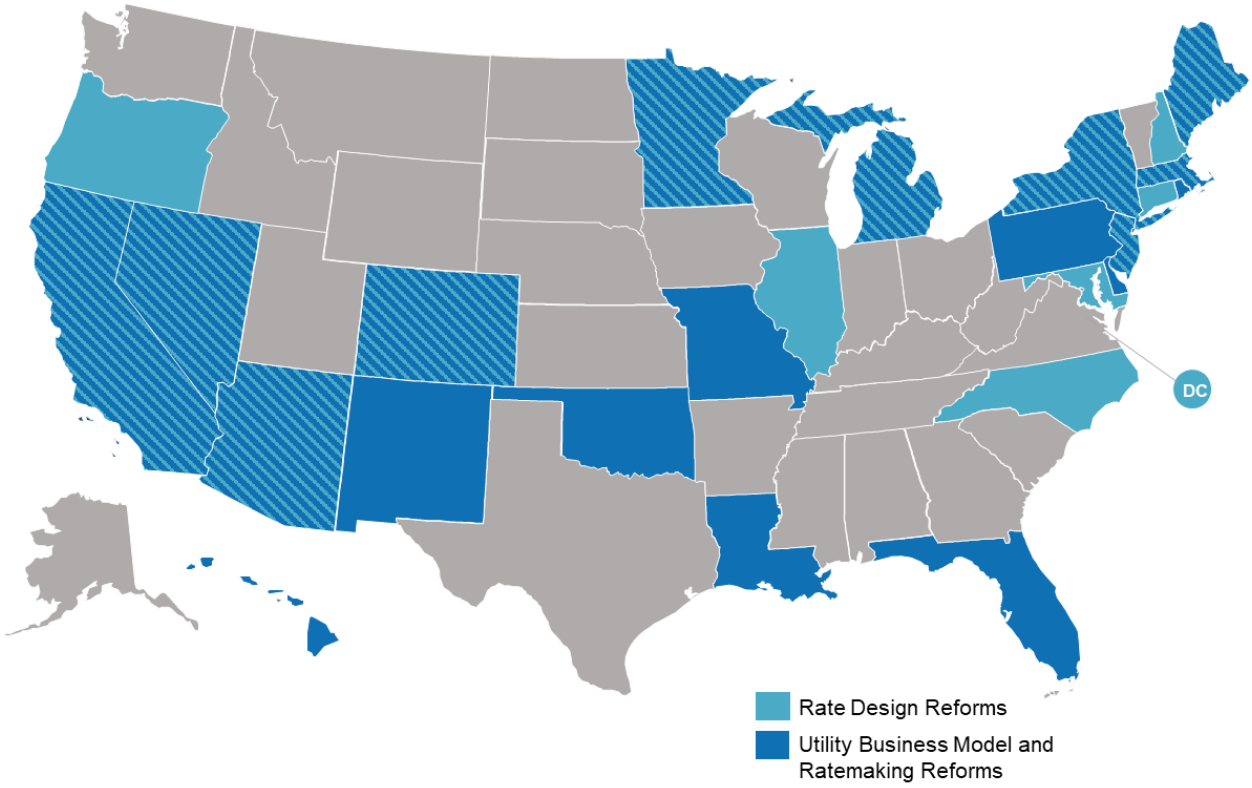


In 2018, a total of 25 states and DC considered changes related to rate designs and utility business models. Of these, 19 states took actions related to ratemaking and utility business model reforms. The most common type of reform under consideration was performance-based ratemaking, with at least nine states considering performance incentive mechanisms. The Hawaii State Legislature enacted a bill requiring a transition to performance-based regulation,

while stakeholders in Minnesota also worked toward developing performance-based incentive metrics. Regulators also considered performance incentive mechanism for utilities in Massachusetts, New York, Oklahoma, and Rhode Island.

Other business model reforms under consideration in 2018 range from decoupling to deregulation. Two utilities in New Jersey proposed decoupling mechanisms in 2018, while the New Mexico Public Regulation Authority opened a proceeding to discuss decoupling mechanisms that could be implemented in Public Service of New Mexico's next rate case. Nevada voters rejected a Constitutional Amendment that would have deregulated the state's electric utility industry, and an effort in Florida ramped up to get a Constitutional Amendment providing wholesale and retail electricity competition on the 2020 ballot.

Figure 14. 2018 Action on Rate Design and Utility Business Models by Type



Fifteen states and DC considered rate design reforms during 2018. These reforms relate to time-varying rates, demand charges, smart home rates, and energy storage tariffs. Arizona regulators directed Tucson Electric Power and UNS Electric to file rates similar to Arizona Public Service's "R-TECH" schedule, which is available to customer with at least two eligible devices, including solar and energy storage. Regulators approved a new time-of-use rate tariff for Xcel Energy in Minnesota, and the New Hampshire Public Utilities Commission approved an energy storage tariff featuring time-of-use rates for use with Liberty Utilities' behind-the-meter storage program.

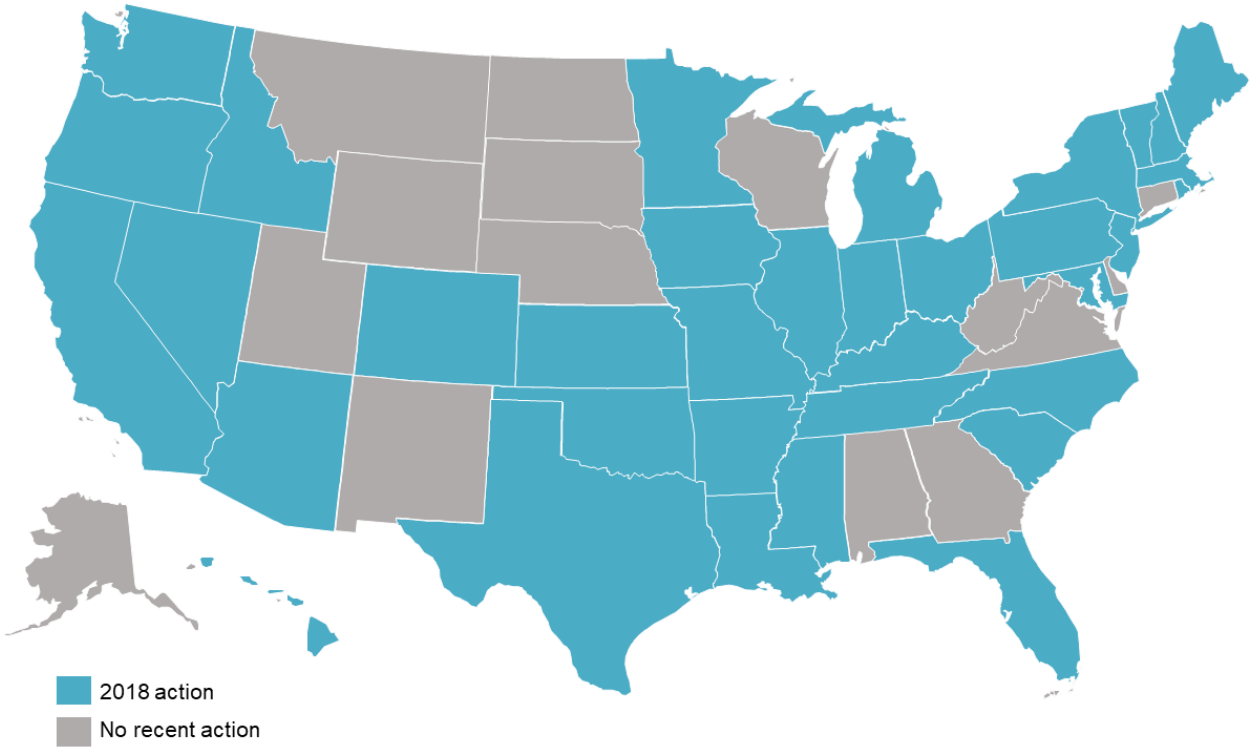
GRID MODERNIZATION POLICIES REVIEW

Key Takeaways:

- In 2018, 35 states plus DC took 113 actions on grid modernization policies, including AMI opt-out rules, energy storage targets, and interconnection standards for energy storage.
- The most commonly addressed policy types of 2018 were AMI rules, energy storage targets, and data access policies.
- States examined a wide range of both new policies related to grid modernization and changes to existing policies during 2018.

There are many different ways in which states may regulate and encourage deployment of grid modernization technologies – examined generally in this report as "policies." Over the course of 2018, a total of 35 states and DC took 113 actions related to grid modernization policies, nearly doubling the number of actions taken by states in 2017.

Figure 15. 2018 Action on Grid Modernization Policies



The most common policy type addressed by states during 2018 was rules and regulations related to advanced metering infrastructure (AMI). Over the course of the year, 18 states considered AMI rules, primarily relating to opt-out rules and fees. Eleven opt-out tariffs proposed by utilities were evaluated, with one-time fees ranging from $0 to $170 and monthly fees ranging

from $5.00 to $25.89. Some utilities' proposed opt-out tariffs also included provisions such as requiring customers to provide a monthly meter reading or requiring a note from a medical physician in order to opt out of AMI installation. Several states considered bills related to AMI opt-out provisions, but none of these were enacted in 2018.

Several states are addressing standards for access to customer usage data, especially as utilities deploy AMI throughout their service territories, making more granular usage data available. The Michigan Public Service Commission considered data access rules in 2018 and directed utilities to file data privacy tariffs. The Arizona Corporation Commission also directed Tucson Electric Power and UNS Electric to file plans for customers to access hourly data through a web-based process. Other data access issues considered in 2018 include rules for providing access to third parties and rules for allowing large building owners to access aggregated whole-building data.

Table 5. Proposed AMI Opt-Out Fees in 2018

State/Utility	One-Time Fee	Monthly Fee
Arkansas (Entergy)	$63.50	$21.80
California (Pacificorp)	$75.00	$20.00
Florida (Duke Energy Florida)	$96.34	$15.60
Indiana (Duke Energy Indiana)	$75.00	$25.89
Iowa (Interstate Power & Light)	$0.00	$15.00
Maryland	*	*
Michigan (H.B. 4220)	$150.00 max	$5.00 max
Michigan (Indiana Michigan Power)	$44.07	$16.77
Michigan (Upper Peninsula Power Co.)	$62.25	$14.26
New Jersey (PSE&G)	$45.00	$20.00
New York	*	*
North Carolina (Duke Energy Carolinas)	$150.00	$11.75
Oklahoma	*	*
South Carolina	*	*
South Carolina (Duke Energy Progress)	$170.00	$14.75
Tennessee	*	*
Washington (Avista)	$75.00	$5.00

* Proposed legislation would prohibit opt-out fees.

Two states – New Jersey and New York – adopted energy storage targets in 2018. New Jersey's target is for 600 MW by 2021 and 2,000 MW by 2030. New York's storage target, announced by the Governor in January 2018, is for 1,500 MW by 2025. The New York Public Service Commission also adopted a target of 3,000 MW by 2030. The Massachusetts General Court also enacted legislation expanding Massachusetts' storage target from 200 MWh by 2020 to 1,000 MWh by 2025.